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EXAMINER

DINH, JACK

ART UNIT

PAPER NUMBER

2873

DATE MAILED: 02/27/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/026,318

Applicant(s)

DEWA, ANDREW S.

Examiner

Jack Dinh

Art Unit

2873

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM  
THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED. (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 20 December 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 27-30 is/are allowed.
- 6) ☒ Claim(s) 1-26 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 March 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

## **DETAILED ACTION**

### ***Information Disclosure Statement***

1. Receipts of Information Disclosure Statements (IDS) with copies of references cited therein were received. An initialized copy of the IDS is enclosed with this Office Action.

### ***Drawings***

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description:

Reference "a--a" on page 5, line 1, was not shown in figure 1;

Reference "a--a" on page 7, line 22, was not shown in figure 1;

Reference "b--b" on page 5, line 4, was not shown in figure 1;

Reference "b--b" on page 8, line 4, was not shown in figure 1;

Reference 161 on page 13, line 6, was not shown in figure 8;

Reference 116 on page 13, line 7, was not shown in figure 8.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: figure 1, reference 28a, 1a, 1c; figure 1a, reference 5; figure 2, reference 122. A proposed drawing correction, corrected

drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

### *Specification*

4. The specification is objected to because of the following informalities:

On page 15, lines 2-4, the cable connection descriptions of reference numbers 196, 193, 195 and 194 do not match with the drawing of figure 11;

The term "resonnant" on page 16, line 5, is misspelled.

Appropriate correction is required.

5. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification. It is respectfully requested that the Applicant file a substitute specification to avoid undue confusion from numerous corrections.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Laor et al. (U.S. Patent No. 6,295,154) in view of McClelland et al. (U.S. Patent Application Publication No. 2001/0022682).

Regarding claims 1 and 17, figure 3 of Laor et al's reference is interpreted as disclosing a micromirror device comprising an outer frame portion (43), a rotational gimbal portion (45) hinged to the frame portion and moveable relative to the frame portion about a first axis (31), an inner rotational mirror portion (47) having a reflective upper face (29) hinged to the gimbal portion for movement of the mirror portion relative to the gimbal portion about a second axis (35), the gimbal portion and mirror portion are formed from a single piece of material (col. 5, lines 13-33). Laor et al discloses all the claimed limitations except for a plurality of truss members disposed beneath at least the inner rotational mirror portion. Within the same field of endeavor, McClelland et al is interpreted as disclosing the teaching of adding a plurality of truss members (91) beneath the mirror portion as shown in figure 23 (paragraph 0112). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to dispose a plurality of truss members beneath the rotational mirror portion to the micromirror device of Laor et al, as taught by McClelland et al, for the purpose of adding stiffness but minimal weight to the mirror portion, which lowers the moment of inertia and increase resonant frequency.

Regarding claims 2 and 18, Laor et al. in view of McClelland et al is interpreted as disclosing all the claimed limitations, as described above, except that the truss members form a plurality of triangular-shaped trusses. Although McClellan does not disclose specifically the trusses are triangular, McClelland discloses that a corrugated, honeycomb, or other structure may

be formed by etching a pattern of wells into the back of the mirror support structure (paragraph 0112). Based on this teaching, the triangular shape is one of many obvious configurations that can be used to form a plurality of trusses. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to form a plurality of triangular-shaped trusses, as taught by McClelland et al, for the purpose of adding stiffness but minimal weight to the mirror portion, which lowers the moment of inertia and increase resonant frequency.

Regarding claims 3, 14 and 19, McClelland et al. is interpreted as disclosing that the mirror portion is 1mm x 2mm or greater (paragraph 0112).

Regarding claims 4 and 20, Laor et al. in view of McClelland et al is interpreted as disclosing all the claimed limitations, as described above, except that the device has a resonant frequency of between about 1000 to 3000 Hertz. Although McClelland does not disclose specifically the resonant frequency range, McClelland discloses that resonant frequencies of over 20 kHz have been demonstrated (paragraph 0021). McClelland further discloses that resonant frequency can be tuned by adjusting the thickness of the mirror (paragraph 0021). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to provide a resonant frequency of between about 1000 to 3000 Hertz, as taught by McClelland et al, for the purpose of selecting a preferred thickness of the mirror and the truss members.

Regarding claims 5, 6, 21, and 22, Laor et al. in view of McClelland et al is interpreted as disclosing all the claimed limitations, as described above. McClelland et al. also discloses that the truss members comprise single crystal silicon (paragraph 0112). Laor in view of McClelland does not disclose the truss members having a height of between about 75 to 100 micrometers.

Although McClelland does not disclose specifically the thickness of the truss members, McClelland discloses the teaching that the choice of thickness results from a tradeoff between mechanical stiffness and moment of inertia (paragraph 0112). Apparently, the thickness of the truss members can be adjusted to tune the resonant frequency of the micromirror device. In addition, given the same width and provided the height can be adjusted, about any height/width aspect ratios can be achieved. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to provide a height and an aspect ratio for the truss members, as taught by McClelland et al, for the purpose of controlling the thickness of the truss members for proper tuning of resonant frequencies.

Regarding claims 7 and 23, Laor et al. in view of McClelland et al is interpreted as disclosing all the claimed limitations, as described above, except that the oxide layer disposed between the mirror and the truss members. Although McClelland does not disclose the oxide layer disposed specifically between the mirror and the truss members, McClelland et al is interpreted as disclosing the teaching that coating oxide or silicon dioxide on to wafers, which are used for mirrors and truss members, is well known in the art for resistant to etches of the wafer material (paragraph 0106). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to dispose an oxide layer between the mirror and the truss members of the micromirror device of Laor et al, as taught by McClelland et al, for the purpose of providing resistant to etches of the mirror and truss members.

Regarding claim 8, Laor et al. in view of McClelland et al is interpreted as disclosing all the claimed limitations, as described above, except that the plurality of truss members disposed beneath the mirror the gimbal portion. Although McClelland does not disclose the plurality of

truss members specifically disposed beneath the gimbal portion, McClelland et al is interpreted as disclosing the teaching of adding a plurality of truss members (91) beneath the mirror portion as shown in figure 23 (paragraph 0112). McClelland further teaches the purpose of the truss members is to add stiffness but minimal weight to the mirror portion, which lowers the moment of inertia and increase resonant frequency. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to dispose a plurality of truss members beneath the gimbal portion to the micromirror device of Laor et al, as taught by McClelland et al, for the purpose of adding stiffness but minimal weight to the gimbal portion, which lowers the moment of inertia and increase resonant frequency.

Regarding claim 9, Laor et al. is interpreted as disclosing that the frame, gimbals, and mirror portion are formed from a single piece of material (col. 5, lines 13-16).

Regarding claims 10 and 24, Laor et al. in view of McClelland et al is interpreted as disclosing all the claimed limitations, as described above, except that the claimed micromirror device or the mirror, frame and gimbal portions are approximately 10 microns thick. The claimed method of manufacturing the micromirror device is to fabricate from bonded SOI wafers. Bonded SOI wafers having thickness of 10 microns is currently standard and available. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to fabricate the mirror, frame and gimbal portions of the micromirror device of Laor et al approximately 10 microns thick.

Regarding claim 11, figure 9 of Laor et al is interpreted as disclosing a magnet (54) attached to the rotational mirror portion (47) (col. 7, line 67 and col. 8, line 1).



Regarding claims 12 and 13, figure 3 of Laor et al is interpreted as disclosing at least one pair of magnets (53a and 53b) positioned opposite each other on a top and bottom face of the gimbal portion and the mirror portion, to symmetrically distribute the pair of magnet's mass about the axis of rotation between the frame and gimbal portions and the gimbal and mirror portions.

Regarding claims 15, 16 and 25, figure 2 of Laor et al discloses an optical switch (15) comprises the claimed micromirror device of claims 1 and 17.

Regarding claim 26, figure 1 of Laor et al. discloses a switching station (1) showing two optical switches (15 and 5).

*Allowable Subject Matter*

7. Claims 27-30 are allowed.

8. The following is a statement of reasons for the indication of allowable subject matter:

The prior art does not show or fairly suggest the claimed invention of a method of manufacturing a micromirror device having the claimed structure and claimed limitations of the independent claims, in such a manner that a rejection under 35 USC 102 or 103 would be improper.

Regarding claim 27, prior art fails to disclose a method of manufacturing a micromirror device comprising providing a silicon on insulator (SOI) wafer having a first layer bonded to a second layer, a thin oxide layer being disposed between the first and second layers, wherein the second layer is thicker than the first layer; removing a portion of the second layer to define a truss member height in the second layer; patterning and etching the truss member height defined areas of the second layer to form a plurality of truss members; and patterning and etching the first layer

to form a frame portion, a gimbal portion disposed within the frame portion, and a mirror portion disposed within the gimbal portion. Therefore, the claimed invention is considered to be in condition for allowance as being novel and non-obvious over the prior art.

### *Conclusion*

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.


Asada et al (U.S. Patent 5,606,447), Laor (U.S. Patent 6,430,332), Laor (U.S. Patent Publication 2002/0018615), Orcutt et al (U.S. Patent Publication 2002/0034024), Orcutt et al (U.S. Patent Publication 2002/0034026), Orcutt et al (U.S. Patent Publication 2002/0070335), Dewa (U.S. Patent Publication 2002/0074310), and Orcutt (U.S. Patent Publication 2002/0075553), and Miyajima et al (U.S. Patent Publication 2002/0118429) disclose micromirror devices.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jack Dinh whose telephone number is (703) 605-0744. The examiner can normally be reached on M-T (8:30 AM - 6:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Georgia Y Epps can be reached on (703) 308-4883. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7724 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

JD  
February 11, 2003



Georgia Epps  
Supervisory Patent Examiner  
Technology Center 2800